ELEC 5760/6760 Final Exam Study Guide

I.   Sensor and Fabrication Terminology

Know terms such as: transducer, measurand, sensor, actuator, SOI wafer and structure, Young's Modulus, MEMS, transmissibility, resistivity, bimorph, Wheatstone bridge, strain gauge, piezoresistor, stiction, types of damping, synchronous demodulation, 2-point/4-point resistance measurement, gauge factor (GF), types of pressure sensors, force feedback, sensitivity, TIA, PTAT, interferometer, spectrometer, analyte, etc…

II.   Sensor Structures

a. Find k (spring constant) from a structure design
b. Determine mass-spring displacement for an applied force
c. Find T(s) from plot of |T(jω)| and vice-versa
d. Know how to relate: m, c, k, Q, ς, ω_n, f_n, displacement to a force

III.   Op Amp Circuit and Sensor Interface Circuit Analysis (homework problems)

IV.   Sensing Methods

a. Conductivity
b. Resistance (temperature effects, strain gauge, piezoresistor)
c. Capacitance (calculating Cnom/max/min, interface circuits)
d. Voltage
e. Current
f. Optical (the different methods)

V.   MEMS Actuators

a. Electrostatic
    (1)   parallel plate actuator (PPA)
    (2)   comb drive actuator (CDA)
    (3)   gap closing actuator (GCA)
b. Piezoelectric
c. Thermal
d. Shape Memory Alloy (SMA)
e. Magnetic

VI.   MEMS Sensors (terminology and analysis)

a. Pressure Sensors (problems and terms)
b. Accelerometers (problems and terms)
c. Gyroscopes (problems and terms)
d. Temperature Sensors (terms)
e. Chemical Sensors (terms)

VII.   Miscellaneous

a. Voltage divider circuits
b. Calculation of a transfer function from a block diagram

VIII.   I will provide (AS NEEDED):

a. Constants: π, ε_o, G, 1 atm in kPa
b. Equations for: Gauge Factor, Resistivity as f(Temp), Resistance as f(resistivity), spring constant, ring oscillator frequency, phase delay cap interface circuit
c. Lapace Transform table
d. Equations for PE, KE, static pressure, actuators, accel/gyro as needed

IX.   You need to know equations for:

a. Ohms law
b. Impedance of a capacitor
c. Capacitance of a parallel plate capacitor
d. $T(s)$ as a function of m, c, k, Q, ς, ω_n
e. Relationships between m, c, k, f_n and ς, Q, ω_n
f. Unit conversions (pF to F, Ω-cm to Ω-m, μm to m, etc…)
g. Units for m, k, c, Q, ς

X.   Things to watch out for:

a. Units on answers
b. Answer all parts of questions
c. Show calculations
d. Convert parameters to a common unit before calculating the answer

XI.   Guide to Studying

a. Exams 1 and 2
b. Homeworks
c. Study guides for Exams 1 and 2
d. Notes, handouts, PowerPoint presentation, lecture videos
e. Sample tests (on class website)

XII.   Test Is Closed Book, Closed Notes, No Laptop/Notebook PC's

Date: Thursday, Dec. 8, 8:00 am to 10:30 am